Application
For

Title 47 USC, Part 2, Subpart J, Paragraph 2.902, Equipment Authorization of Verification for an Unintentional Radiator per Part 15, Subpart B, Paragraphs 15.107 and 15.109

And

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247

For the

Okyanus Teknoloji Biligisayar ve Yazilim San.Tic.

Model Numbers: FT-05FL, FT-05FLC_O, FT-05FL_O, FT-05FLC

FCC ID: 2AUFI-FT-05FL

UST Project: 19-0287

Issue Date: November 5, 2019

Total Pages:46

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I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date: November 5, 2019

TESTING

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Okyanus Teknoloji Biligisayar ve Yazilim San.Tic.

MODELS: FT-05FL, FT-05FLC_O, FT-05FL_O, FT-05FLC
FCC ID: 2AUFI-FT-05FL
DATE: November 5, 2019

This report concerns (check one): Original grant [X]
Class II change

Equipment type: 2.4 GHz Transmitter Module (IEEE 802.15.4)

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____N/A_____
date
agrees to notify the Commission by N/A
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Transmitter details:
IEEE 802.15.4 (ZigBee) transceiver device
Output power: 21.2 dBm (131.8 mW)
Frequency of operation: 2405-2480 MHz

Summary of Test Results

FCC Rule	Description of Test	Result
15.247(b)(3)	Peak Output Power	PASS
15.247(a)(2)	6 dB Bandwidth	PASS
15.247(d)	Conducted & Radiated Spurious Emissions	PASS
15.247(e)	Power Spectral Density	PASS
15.209	Spurious Radiated Emissions	PASS
15.207	Power line Conducted Emissions	PASS

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1 General Information

1.1 Purpose of this Report

This report is prepared to show that the OKYANUS TEKNOLOJI BILGISAYAR VE YAZILIM SAN. TIC. Models FT-05FL, FT-05FLC_O, FT-05FL_O, and FT-05FLC comply with the FCC Rules and Regulations of Part 15.247 Subpart C, technical requirements for intentional radiators.

The host device incorporates three radios: one 2.4 GHz IEEE 802.15.4 (ZigBee) radio and two UWB radios that are identical and transmit simultaneously on the same fundamental frequency. The test data presented in this report shows the worst case results. No additional emissions were generated due to simultaneous transmission beyond the emissions reported in this test report. The maximum permissible exposure (MPE) exhibit will show the summation of all emissions from the ZigBee radio.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on July 25, 2019 in good operating condition.

1.3 Product Description

The Equipment under Test (EUT) is the Okyanus Teknoloji Biligisayar ve Yazilim San. Tic. Model FT-05FL. The EUT is a two part collision avoidance system and is a member of the Okyanus Teknoloji Biligisayar ve Yazilim San.Tic. family. The first part is the Collision Avoidance Alarm Center which gives visual and buzzer warnings and has a display which can adjust measurement between reader and personnel tags or forklifts. The second part is the Collision Avoidance Reader which sends messages to the alarm center via RF transmissions.

The EUT being evaluated throughout this report is the Collision Avoidance Reader. It incorporates two different wireless radio technologies. The first is a 2.4 GHz ISM band radio (Zigbee) utilizing IEEE 802.15.4 technology and the second is a radio that utilizes Ultra Wide Band (UWB) technology. This evaluation is for the Zigbee radio feature.

The device comes in 4 Versions, bearing 4 different Model Numbers:

1. FT-05FLC_O - (Interactive + Relay Output) - This is the full version of the device and is the version used as the representative worst-case sample for testing to cover all 4 models. It has two 4.4 GHz UWB radios and one 2.4 GHz RF radio. It is designed to operate with the other Collision Avoidance Readers. It transmits data and the other safe-zone devices detect this signal. The purpose of this is to prevent collisions between vehicles. There are three relay outputs in the Collision Avoidance Alarm Center that are used with this model. This allows customers to have contact outputs when an alarm occurs.

2. FT-05FL_O – (Relay Output) - This device is identical to the FT-05FLC_O but does not contain a second UWB radio.

3. FT-05FLC – (Interactive) - This device is identical to the FT-05LC_O except that it does not provide any relay outputs in the Collision Avoidance Alarm Center.

4. FT-05FL – This device is identical to the FT-05LC_O except that it has neither the second UWB radio nor the relay outputs.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for the intentional radiator aspect of the device and *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)* for the unintentional radiator aspect of the device as well as FCC subpart B and C of Part 15 and per FCC KDB Publication number 558074 v03r05 for Digital Transmission Systems Operating Under section 15.247.

Digital RF conducted and radiated emissions data below 1 GHz were taken with the measuring receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1.0 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was set to 3 times the RBW or as required per the standard throughout the evaluation process.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is US5301. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittal(s)/Grant(s)

The EUT is subject to the following FCC Equipment Authorizations:

a) Certification of the transmitter incorporated within the EUT, see test data presented herein.

Table 1. Supporting Equipment

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
EUT Okyanus Teknoloji Biligisayar ve Yazilim San.Tic.	FT-05FL	Engineering Sample	2AUFI-FT-05FL	P
Antenna See antenna details	--	--	--	--

S= Shielded, U= Unshielded, P= Power, D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are included herein.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	8/17/2020
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/25/2019
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	5/7/2020
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	4/8/2020
LOOP ANTENNA	6502	EMCO	9810-3246	1/22/2020
BICONICAL ANTENNA	3110B	EMCO	9307-1431	10/23/2019 2 yr. cal.
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	2/1/2021 2 yr. cal.
HORN ANTENNA	3115	EMCO	9107-3723	11/28/2020 2 yr. cal.
HIGH PASS FILTER	H3R020G2	MICROWAVE CHIRCUITS	001DC9528	4/2/2020
8 dB ATTENUATOR	VAT-8 15542	MINI-CIRCUITS	30519	10/31/2019
LISN	9247-50-TS-50-N	Solar Electronics	955824	4/3/2020
LISN	9247-50-TS-50-N	Solar Electronics	955825	4/3/2020

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15.247 or IC RSS-210 requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 as follows:

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates over 2.4 GHz to 2.4835 GHz, 3 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT without going below 9 kHz to the 10th harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be investigated from 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following parameters:

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the resolution bandwidth shall be at least 1 MHz.

2.6 EUT Antenna Requirements (CFR 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this module.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Flat Patch Antenna	Antenova	Flex Flat Patch	SRF2W021 -100	2.8	u.FL

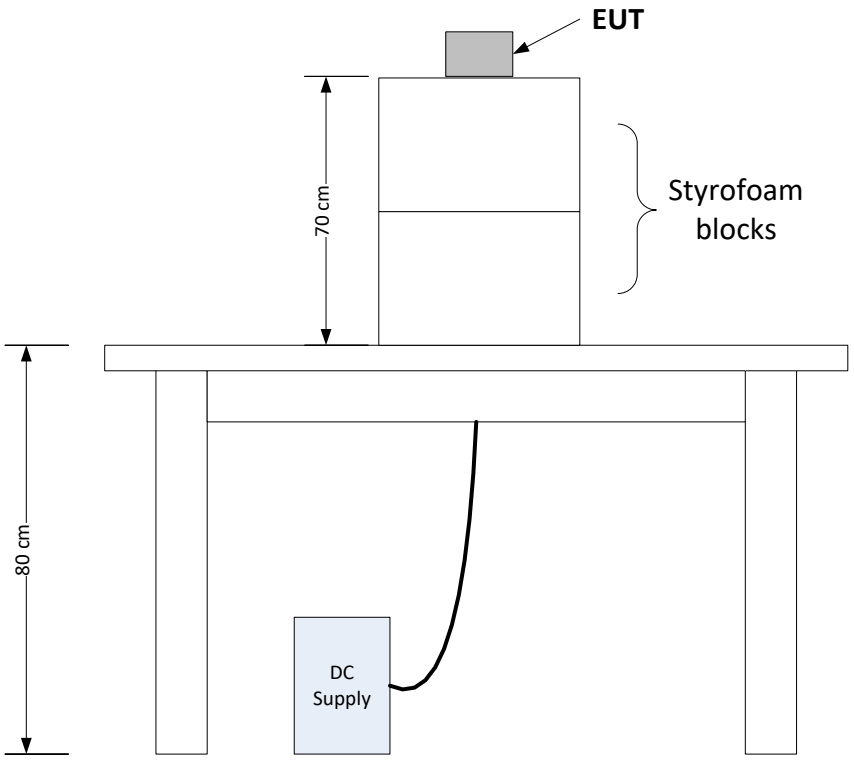


Figure 1. Block Diagram of Test Configuration

2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious emissions cannot exceed the limits of 15.209. Radiated harmonics and other spurious emissions are examined for this requirement (see paragraph 2.10).

2.8 Transmitter Duty Cycle (Part15.35 (c))

The EUT employs pulse transmission however for testing purpose the EUT was programmed to transmit at a rate >98%. The pulse transmission requirements of this subpart were acknowledge and considered during testing.

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may also be expressed logarithmically in dB.

Figure 2. Duty Cycle Plots

Note: There is only a single pulse in a 100 mSec time interval.

DC correction factor = 20 log (TXon/100mSec) = 20*log (0.0313) = **-30.1 dB**

2.9 Antenna Conducted Intentional and Spurious Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a))

The EUT does not provide access to an antenna port; therefore, the EUT was put into a continuous-transmit mode of operation and tested per ANSI C63.10-2013 for radiated out of band emissions over the frequency range of 30 MHz to 10 times the highest clock frequency generated or used. In this case, the EUT was tested up to 25 GHz. A radiated scan was performed on the EUT to identify and record spurious signals that were related to the transmitter. Antenna radiated emissions of a significant magnitude that fell within restricted bands were then maximized in a semi-anechoic chamber. The radiated emissions graphs are found in Figures 3 through 8 following. The limit for antenna radiated power is 0.0459 Watt (-41.23 dBm (EIRP)) per 15.247 (b)(3).

For radiated RF antenna tests, the RBW was set to 120 kHz and video bandwidth (VBW)> RBW over a frequency range of 30 MHz to 1 GHz. For the frequency range above 1 GHz and up to the 10th harmonic of the fundamental frequency, the RBW was set to 1 MHz and VBW>RBW. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band.

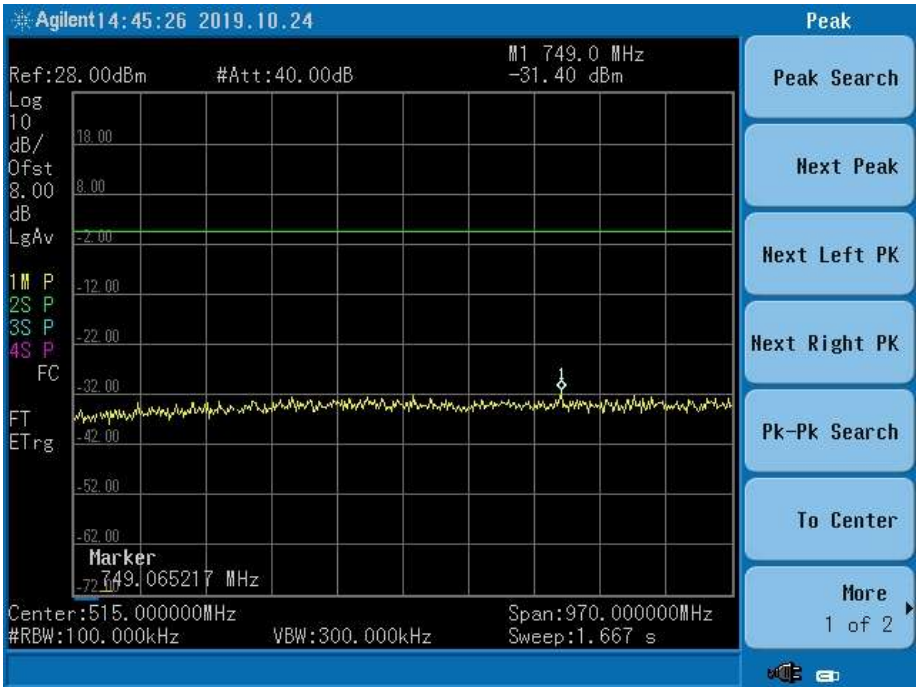


Figure 3. Low Channel, 30 - 1000 MHz

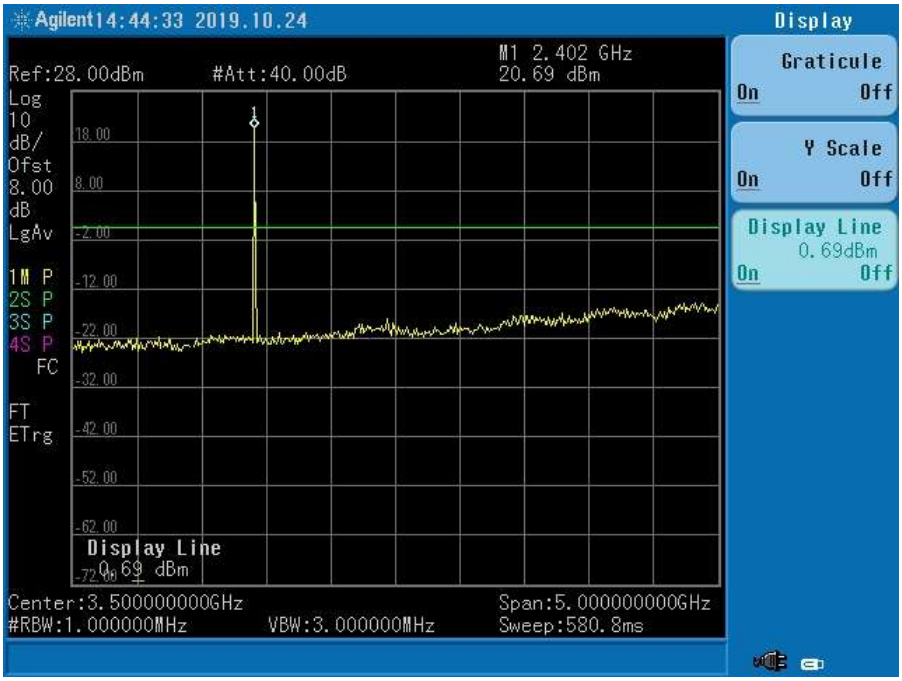


Figure 4. Low Channel, 1 GHz - 6 GHz

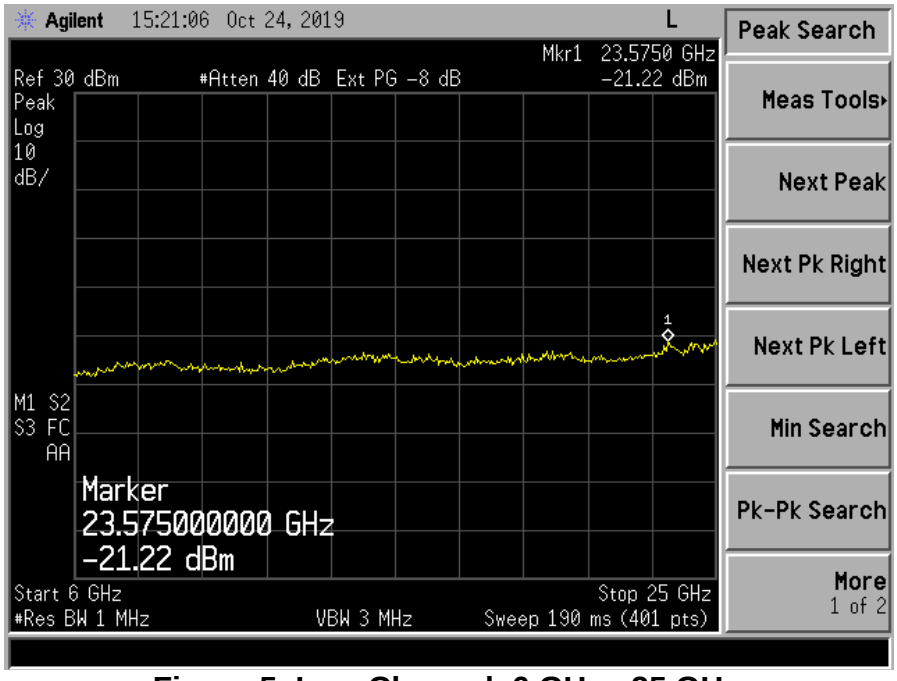


Figure 5. Low Channel, 6 GHz - 25 GHz

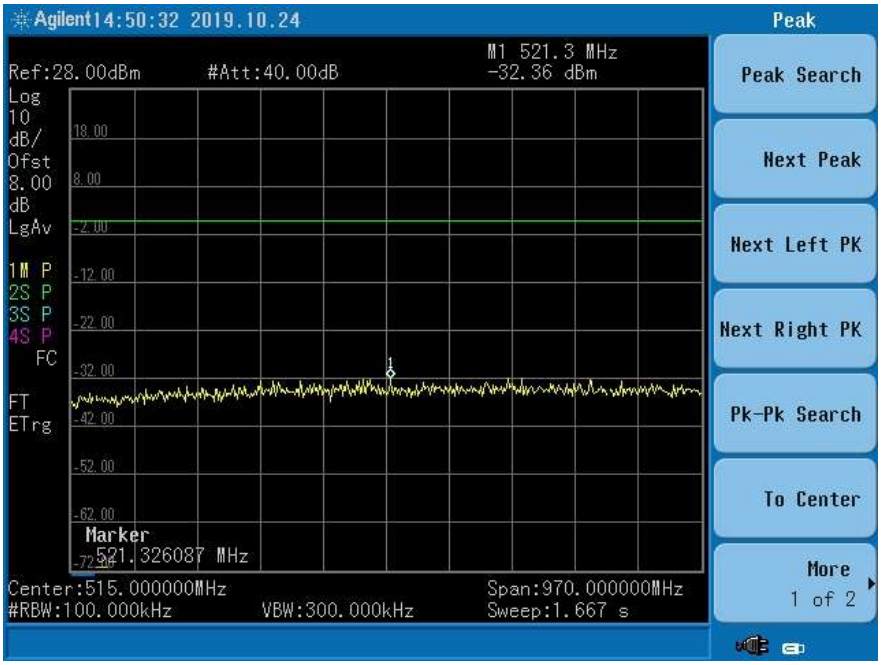


Figure 6. Mid Channel, 30 MHz - 1000 MHz

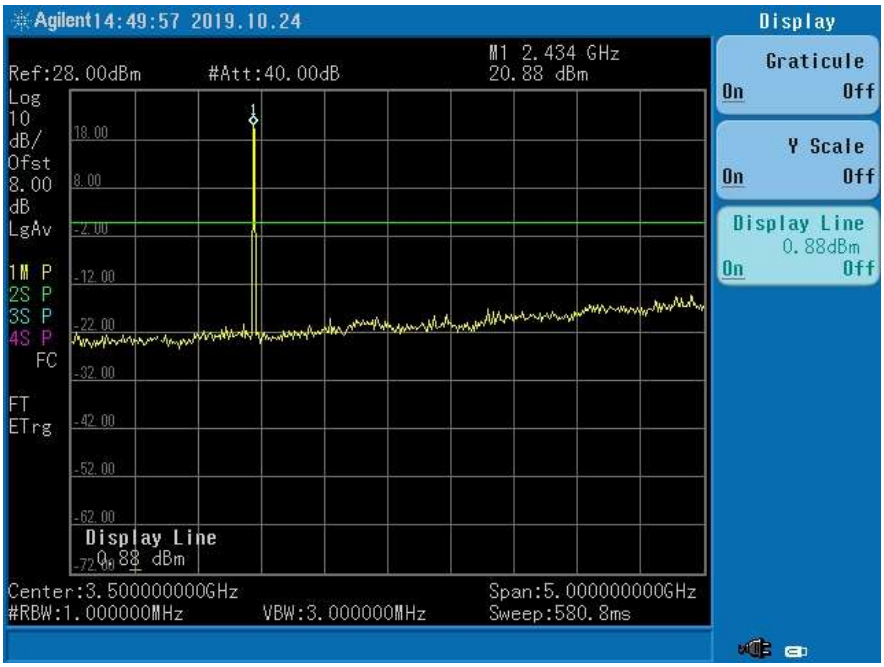


Figure 7. Mid Channel, 1 GHz - 6 GHz

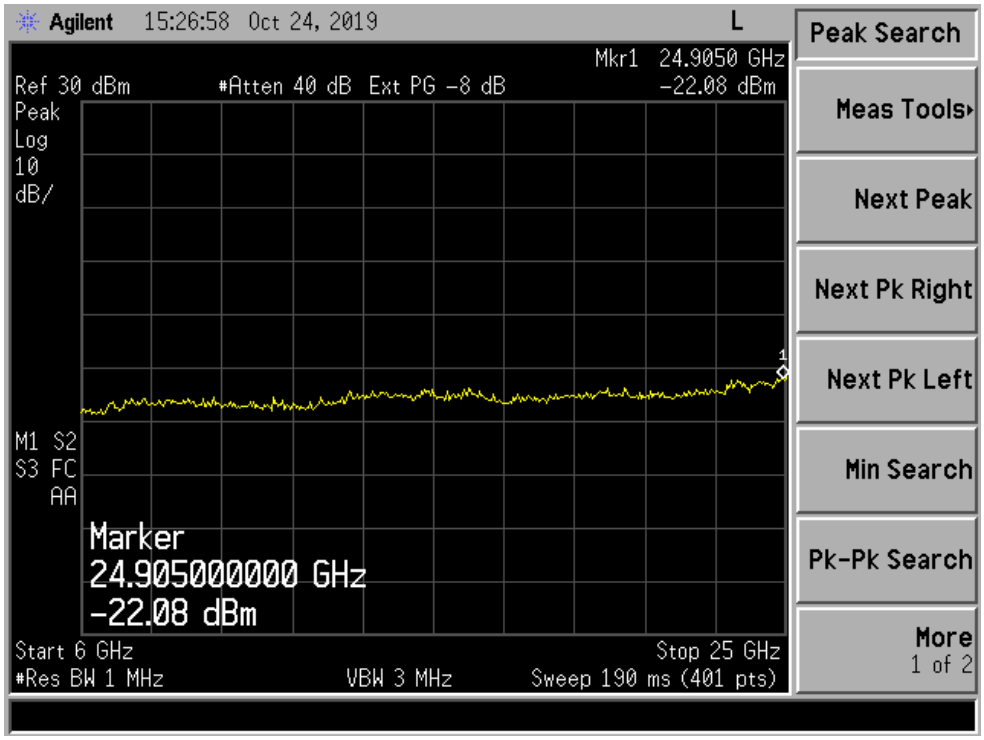


Figure 8. Mid Channel, 6 GHz - 25 GHz

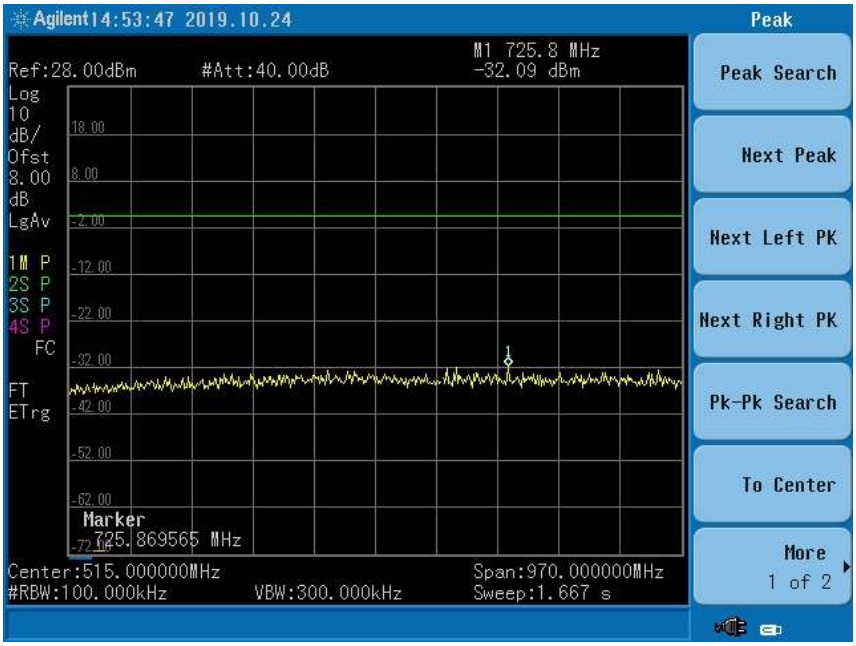


Figure 9. High Channel, 30 MHz - 1000 MHz

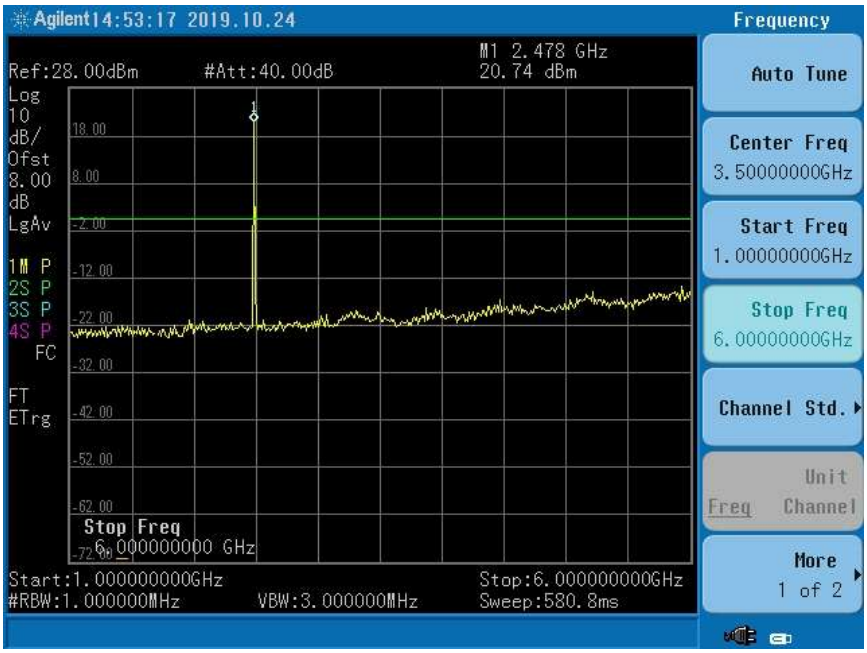


Figure 10. High Channel, 1 GHz - 6 GHz

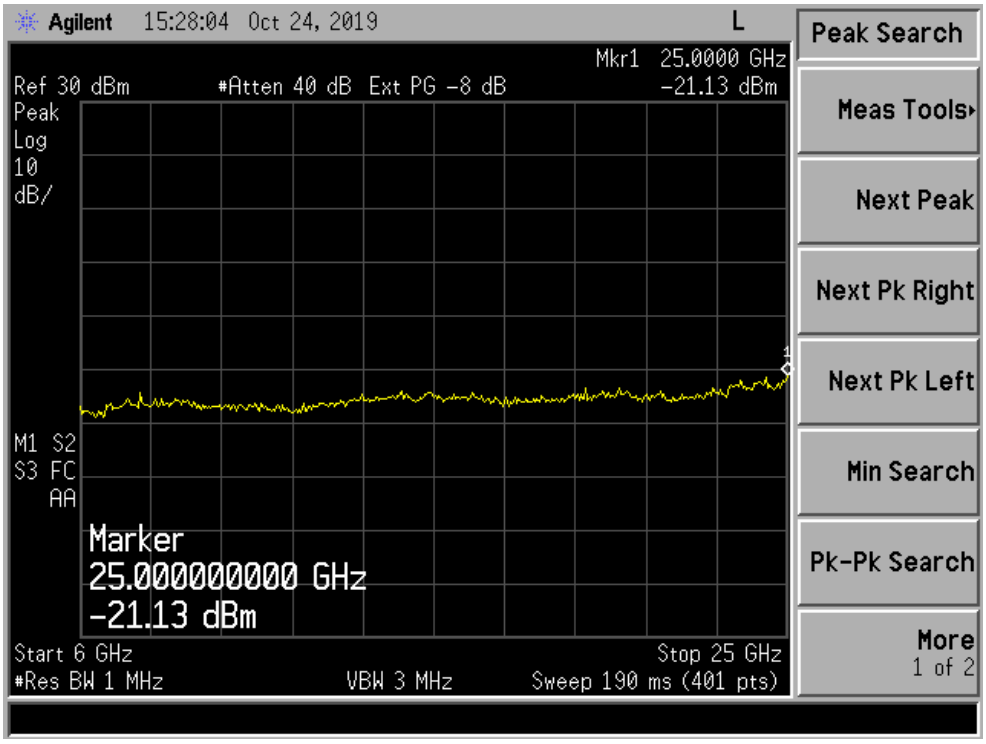


Figure 11. High Channel, 6 GHz - 25 GHz

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d))

On the test site, the EUT was placed on top of a non-conductive table, 80 cm above the floor for measurements below 1 GHz and 150 cm above the floor for measurements > 1 GHz. The EUT was also evaluated in three orthogonal positions to determine the worst case position. The front of the EUT faced the measurement antenna located 3 meters away. Each signal measured was maximized by raising and lowering the receive antenna between 1 and 4 meters in height while monitoring the ever changing spectrum analyzer display with Trace 1 in the Clear-Write mode and Trace 2 in the Max-Hold mode for the largest signal visible. That exact antenna height where the signal was maximized was recorded for reproducibility purposes. Additionally, the EUT was rotated about its Y-axis 360 degrees clockwise and counterclockwise while monitoring the Spectrum Analyzer display for maximum. The EUT azimuth was recorded for reproducibility purposes. The emissions from the EUT were measured when both maxima were simultaneously satisfied.

For radiated measurements, the EUT was set into a continuous transmission mode. Below 1 GHz, the RBW of the measuring instrument was set equal to 120 kHz. Peak measurements above 1 GHz were measured using a RBW equal to 1 MHz, with a VBW ≥ RBW. The results of peak radiated spurious emissions falling within restricted bands are given in Table 5 below.

For average measurements above 1 GHz, the emissions were measured using RBW = 1 MHz and VBW = 10 Hz or the duty cycle correction factor was applied to the Peak recorded value. The results of average radiated spurious emissions falling within restricted bands are given in Table 5 below.

Table 5. Peak Radiated Fundamental & Harmonic Emissions

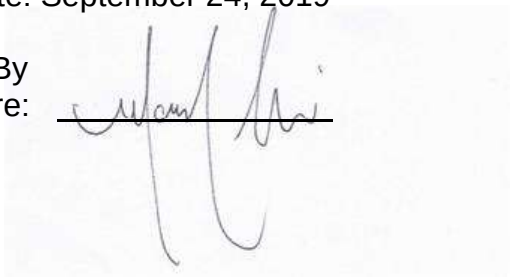
Tested By: MA	**Test:** FCC Part 15,247(d)			**Client:** Okyanus Teknoloji Biligisayar ve Yazilim San.Tic.				
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
	Low Channel - PEAK							
2405	118.5	--	-1.90	116.60	--	3.0m./HORZ	--	**PK**
*4810	51.99	--	6.08	58.07	74.0	3.0m./HORZ	15.9	**PK**
	Mid Channel - PEAK							
2440	85.13	--	33.85	118.98	--	3.0m./HORZ	--	**PK**
*4880	43.58	--	5.35	48.93	74.0	3.0m./HORZ	25.1	**PK**
*7320	45.40	-9.5	11.10	47.00	74.0	1.0m./VERT	27.0	**PK**
	High Channel– PEAK							
2480	116.10	--	-1.66	114.44	--	3.0m./HORZ	--	**PK**
*4960	46.22	--	6.45	52.67	74.0	3.0m./HORZ	21.3	**PK**
*7440	43.96	-9.5	11.06	45.52	74.0	1.0m./HORZ	28.5	**PK**

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209& 15.247.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

Sample Calculation at 2405.00 MHz:

Magnitude of Measured Frequency	118.50	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	-1.90	dB/m
Corrected Result	116.60	dBuV/m

Test Date: September 24, 2019

Tested By
Signature: 

Name: Mark Afroozi

Table 6. Average Radiated Fundamental & Harmonic Emissions

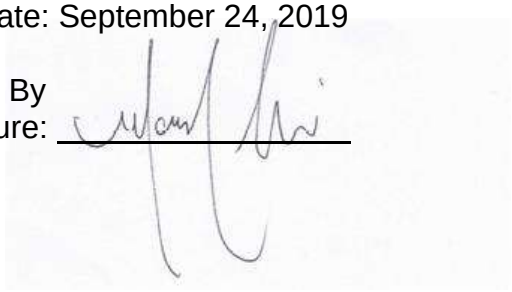
Tested By: MA	**Test:** FCC Part 15,247(d)			**Client:** Okyanus Teknoloji Biligisayar ve Yazilim San.Tic.				
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
	Low Channel - Average							
2405	46.88	--	-1.90	44.98	--	3.0m./HORZ	--	**AVG**
*4810	27.07	--	6.08	33.15	54.0	3.0m./HORZ	20.9	**AVG**
	Mid Channel–Average							
2440	25.38	--	33.85	59.23	--	3.0m./HORZ	--	**AVG**
*4880	27.14	--	5.35	32.49	54.0	3.0m./HORZ	21.5	**AVG**
*7320	26.55	-9.5	11.01	28.06	54.0	1.0m./HORZ	25.9	**AVG**
	High Channel–Average							
2480	48.76	--	-1.66	47.10	--	3.0m./HORZ	--	**AVG**
*4960	27.20	--	6.45	33.65	54.0	3.0m./HORZ	20.3	**AVG**
*7440	26.03	-9.5	11.06	27.59	54.0	1.0m./HORZ	26.4	**AVG**

1.(*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. Duty cycle applied where applicable.

Sample Calculation at 2405.00MHz:

Magnitude of Measured Frequency	46.88	dBuV
+Additional Factor (filter + duty cycle)	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	-1.90	dB/m
Corrected Result	44.98	dBuV/m

Test Date: September 24, 2019

Tested By
Signature: 

Name: Mark Afroozi

2.11 Band Edge Measurements – (CFR 15.247 (d))

Band Edge measurements are made following the guidelines in ANSI C63.10-2013 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port radiated measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band). Because these frequencies occur above 1000 MHz they have both a peak and average requirement.

To capture the band edge the Spectrum Analyzer's frequency span was set large enough to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Measurements were performed with RBW = 100 kHz and VBW is set ≥ RBW. See figures and calculations below.

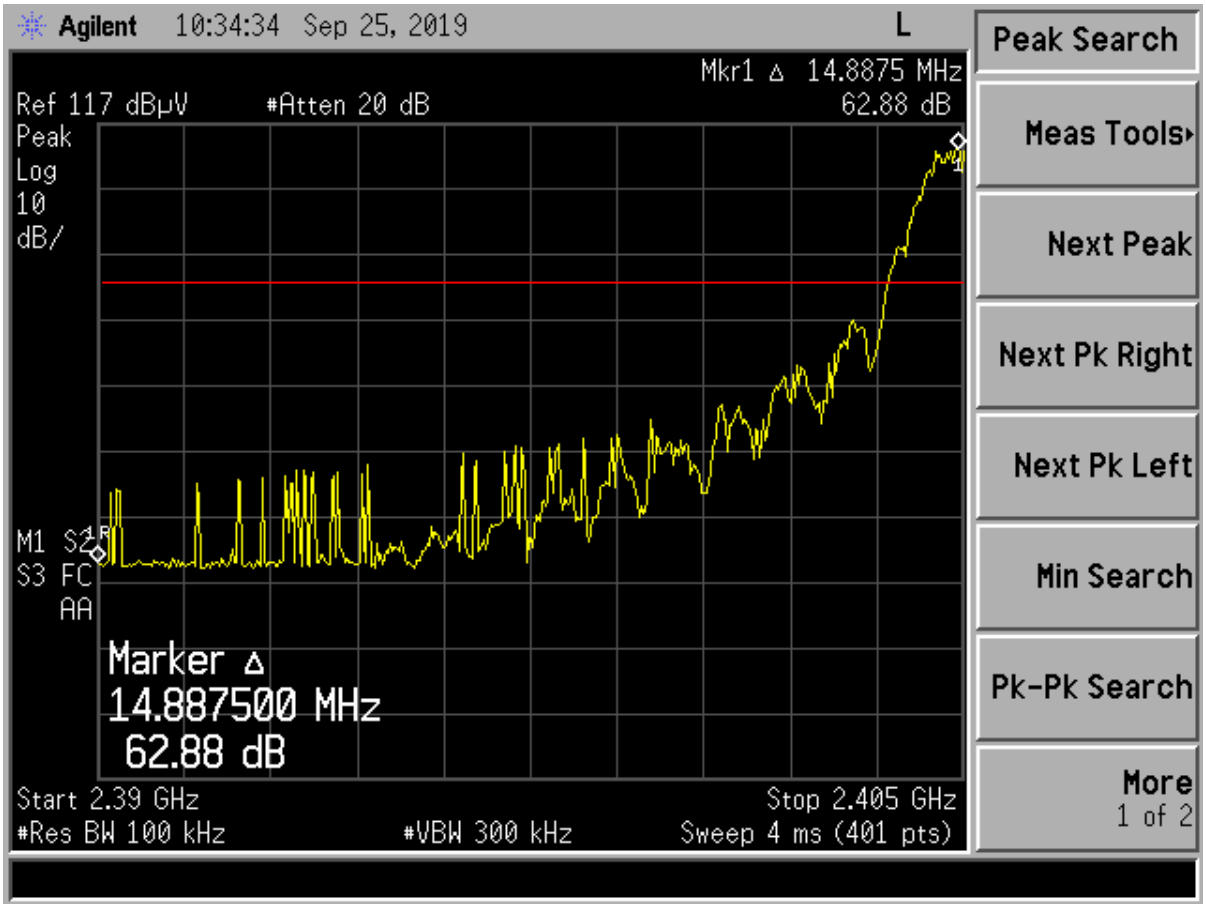


Figure 12. Band Edge Compliance, Low Channel, Delta - Peak

Lower band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	62.88	dB
Band Edge Limit	20.00	dB
Band Edge Margin	42.88	dB

Figure 13. Band Edge Compliance, High Channel, Delta – Peak

Lower band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	50.06	dB
Band Edge Limit	20.00	dB
Band Edge Margin	30.06	dB

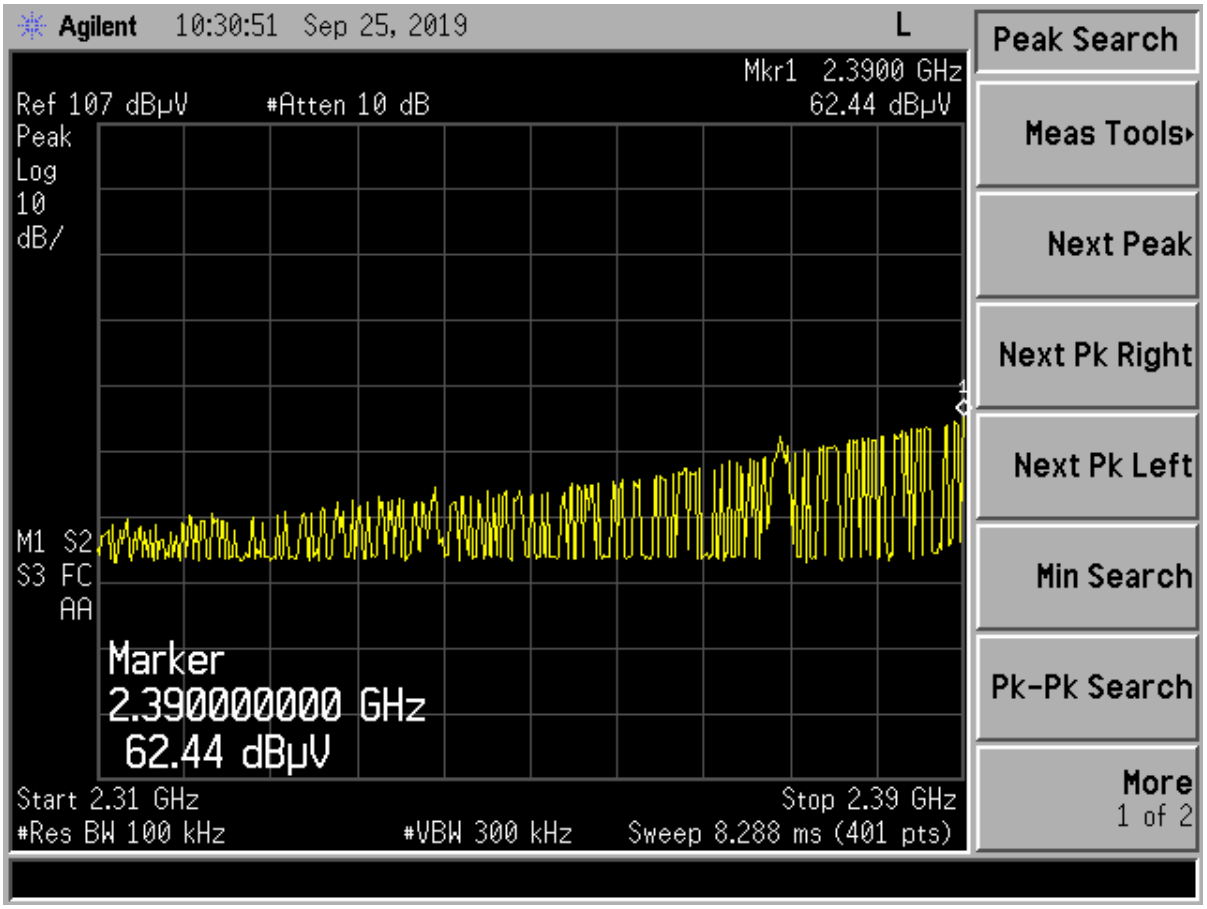


Figure 14. Restricted Band, Low Channel

Low Channel – Restricted Band Edge								
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
2390.00	62.44	--	-3.00	59.44	74.0	3.0m./HORZ	14.6	**PK**
2390.00	62.44	-30.1	-3.00	29.34	54.0	3.0m./HORZ	24.7	**AVG**

Note: Duty cycle correction factor applied to PK value to calculate the corrected AVG value.

Sample calculation:
2390 MHz, 62.44 dBuV/m – 30.1 dB + (-3.00) dB = 29.34 dBuV/m

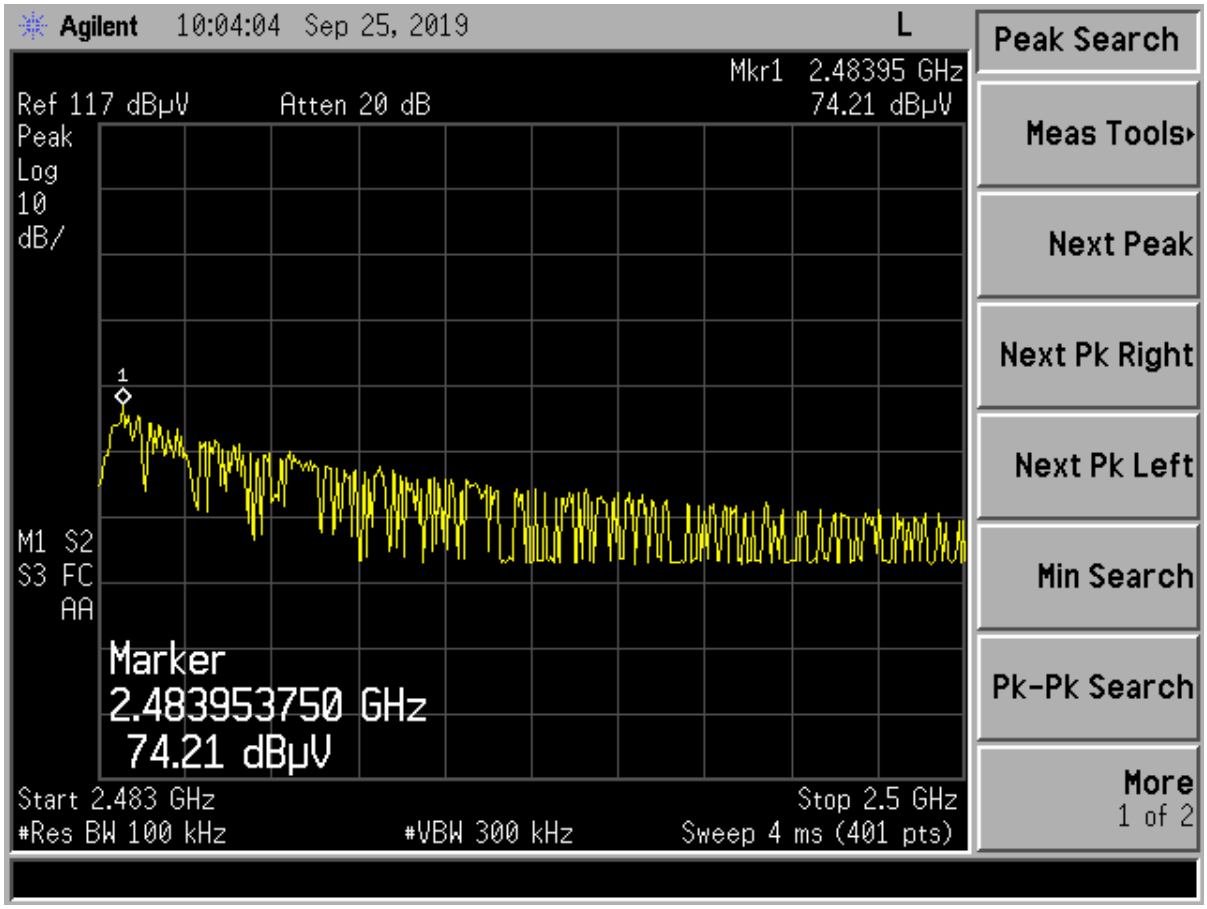


Figure 15. Restricted Band, High Channel

High Channel – Restricted Band Edge								
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
2483.95	74.21	--	-1.66	72.55	74.0	3.0m./HORZ	1.5	**PK**
2483.95	74.21	-30.1	-1.66	42.45	54.0	3.0m./HORZ	11.6	**AVG**

Note: Duty cycle correction factor applied to PK value to calculate the corrected AVG value.

Sample calculation:
2483.95 MHz, 74.21 dBuV/m – 30.1 dB + (-1.66) dB = 42.45 dBuV/m

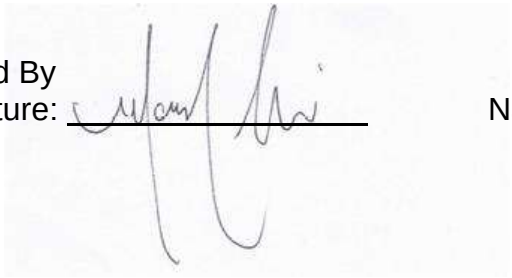
2.12 Six (6) dB Bandwidth per CFR 15.247(a)(2)

Measurements were performed per ANSI C63.10-2013, clause 11.8 The RBW was set to 100 kHz and the VBW ≥ RBW. The results of this test are given in the table and figures following.

Table 7. Six (6) dB Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum FCC Bandwidth (MHz)
2405	1.431	0.5
2440	1.528	0.5
2480	1.608	0.5

Test Date: October 21, 2019

Tested By
Signature:  Name: Mark Afroozi

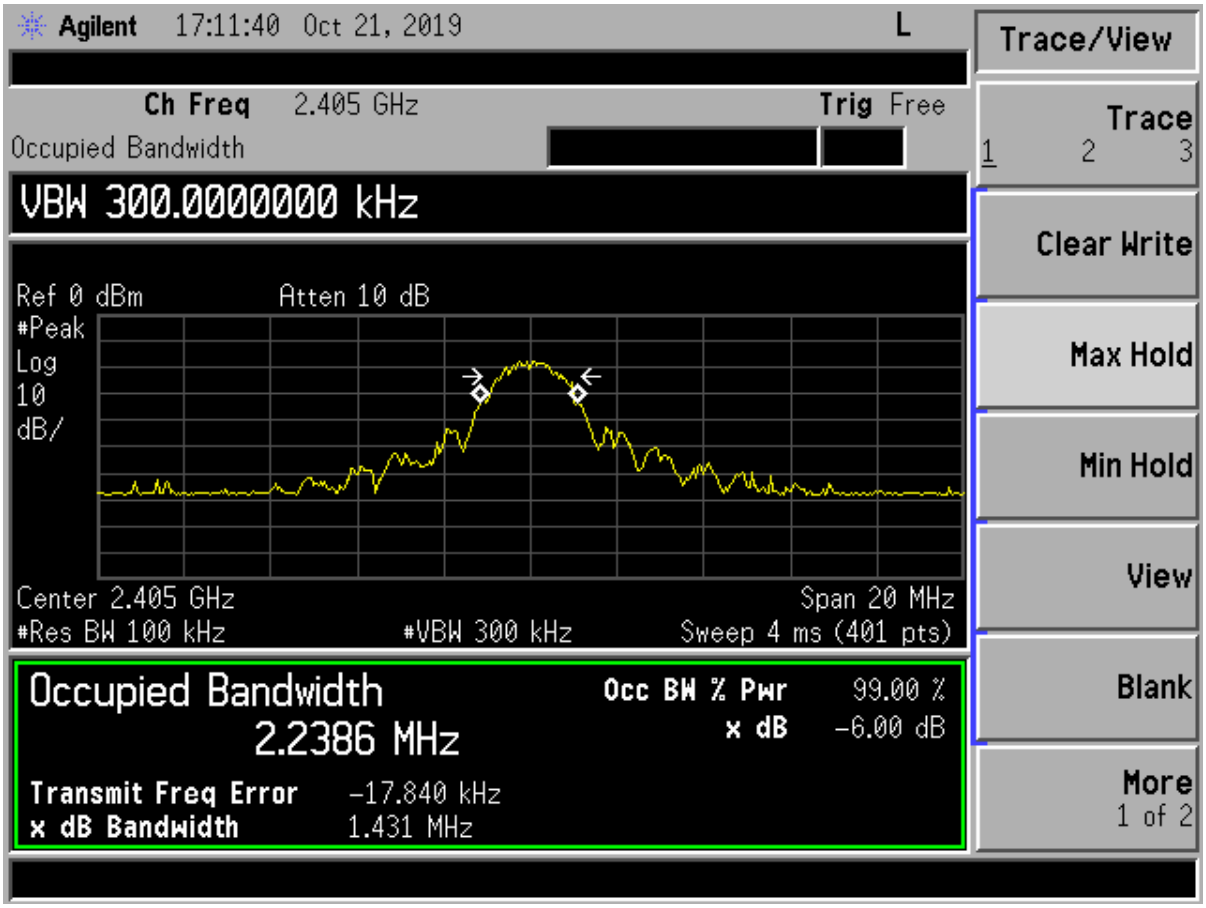


Figure 16. 6 dB Bandwidth, Low Channel

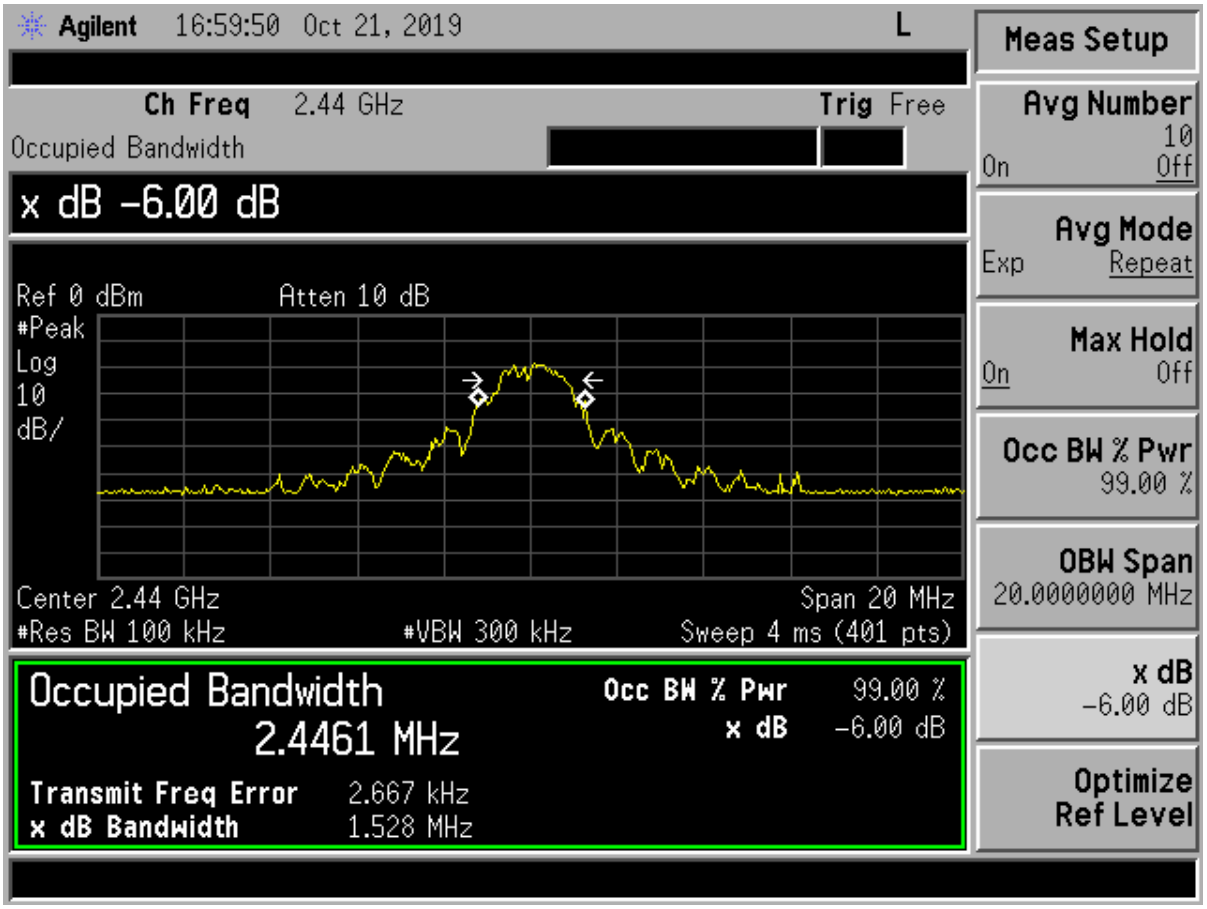


Figure 17. 6 dB Bandwidth, Mid Channel

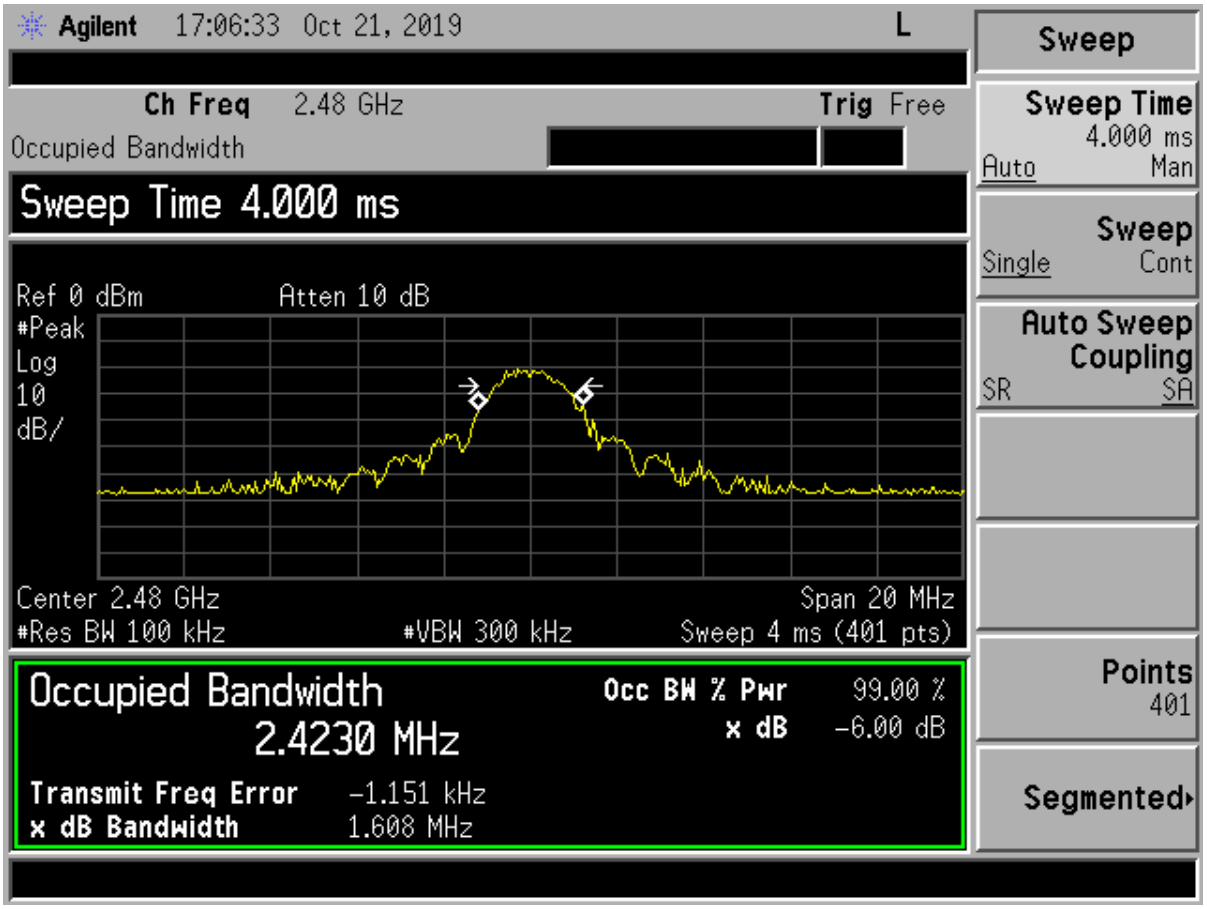


Figure 18. 6 dB Bandwidth, High Channel

2.13 Maximum Peak Conducted Output Power (CFR 15.247 (b) (3))

The transmitter was programmed to operate at a maximum output power across the bandwidth.

Peak power within the band 2400 MHz to 2483.5 MHz was measured per ANSI C63.10-2013 as an Antenna Conducted test with a spectrum analyzer. The antenna port was connected directly to the spectrum analyzer via a short RF cable. An 8 dB attenuator was connected to the RF input port of the spectrum analyzer and calibrated for attenuator loss. The spectrum analyzer was set to a RBW of 1 MHz, and the VBW ≥ RBW. Peak antenna conducted output power is tabulated in the table below.

Table 8. Peak Antenna Conducted Output Power per Part 15.247 (b)(3)

Frequency of Fundamental (MHz)	Raw Test Data dBm	Converted Data (mW)	FCC Limit (mW Maximum)
2405	20.85	121.62	1000
2440	20.87	114.02	1000
2480	21.15	130.32	1000

Test Date: October 24, 2019

Tested By
Signature: _____ Name: George Yang

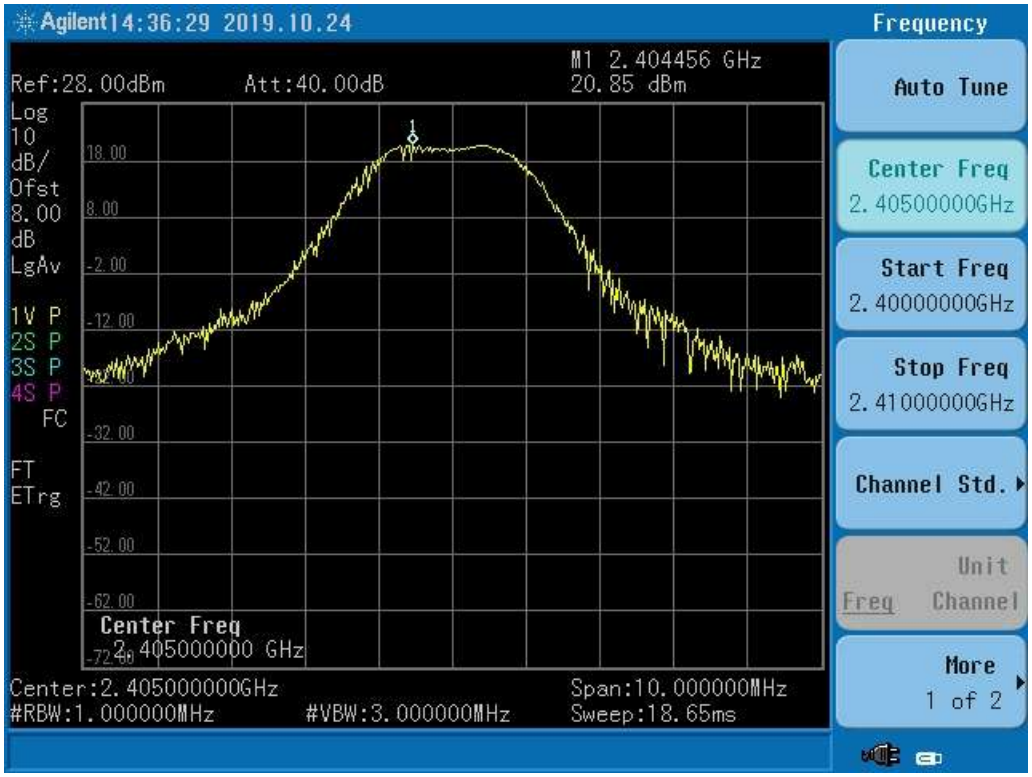


Figure 19. Peak Antenna Conducted Output Power, Low Channel

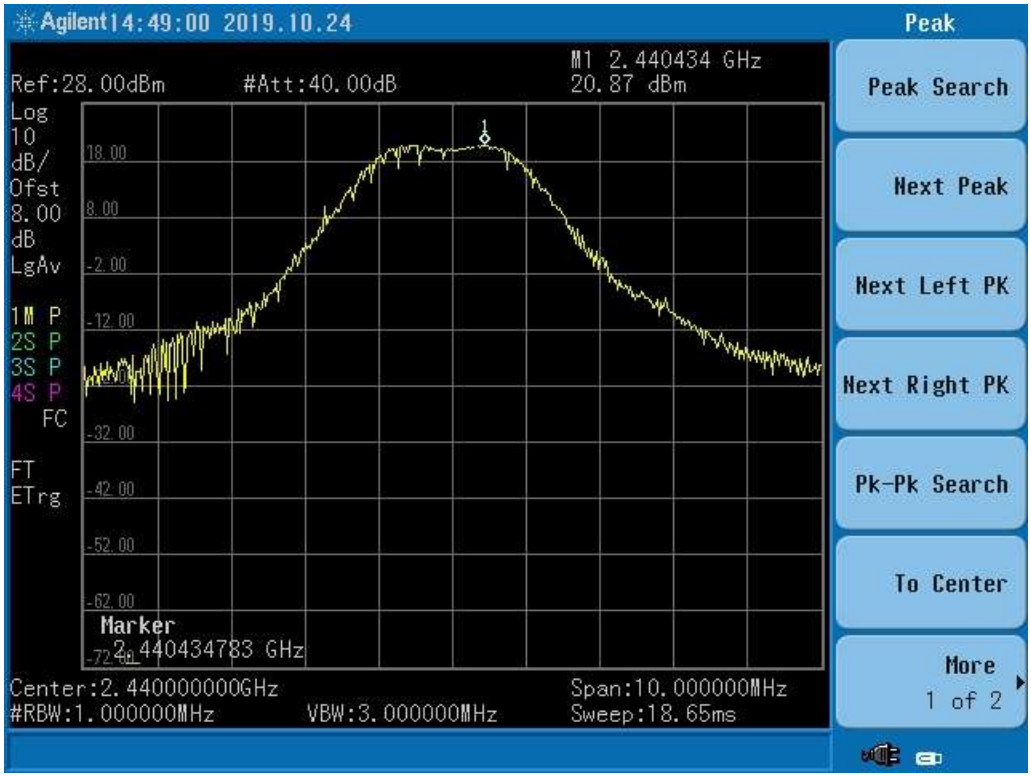


Figure 20. Peak Antenna Conducted Output Power, Mid Channel

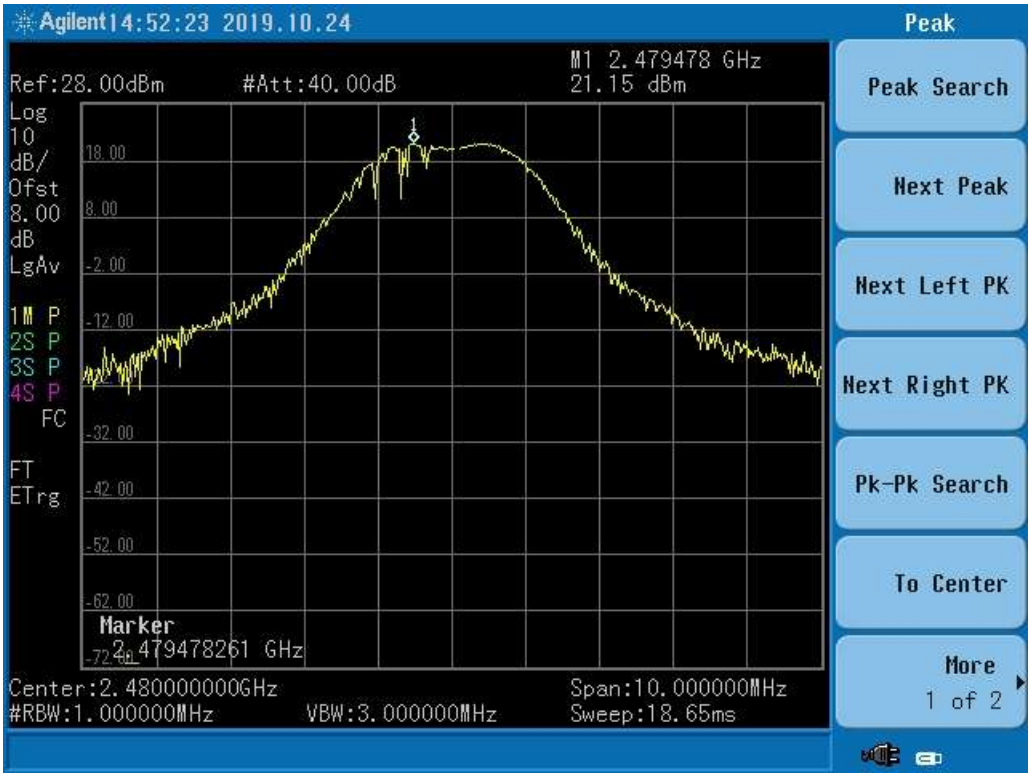


Figure 21. Peak Antenna Conducted Output Power, High Channel

2.14 Power Spectral Density (CFR 15.247(e))

The transmitter was placed into a continuous mode of operation at all applicable frequencies. The measurements were performed per the procedures of ANSI C63.10-2013. The RBW was set to 3 kHz and the Video Bandwidth was set to ≥ RBW. The trace capture time was set to (Span/3 kHz).

In accordance with 15.247 (e), the power spectral density shall be no greater than +8 dBm per any 3 kHz band.

Results are shown in the table and figures below. All are less than +8 dBm per 3 kHz band.

Note: dBm/Hz correct to dBm/kHz using the following formula, 10 log RBWref/RBW measured.

Table 9. Power Spectral Density for Low, Mid and High Bands

Frequency (MHz)	Measured (dBm/Hz)	Results (dBm/3 kHz)	FCC Limit (dBm/3 kHz)
2405	-45.95	-11.18	+8.0
2440	-45.30	-10.53	+8.0
2480	-45.84	-11.07	+8.0

Sample calculation: -45.95 dBm/Hz + (10*log (3000/1)) = -11.18 dBm/3 kHz

Test Date: October 24, 2019

Tested By
Signature:  Name: George Yang

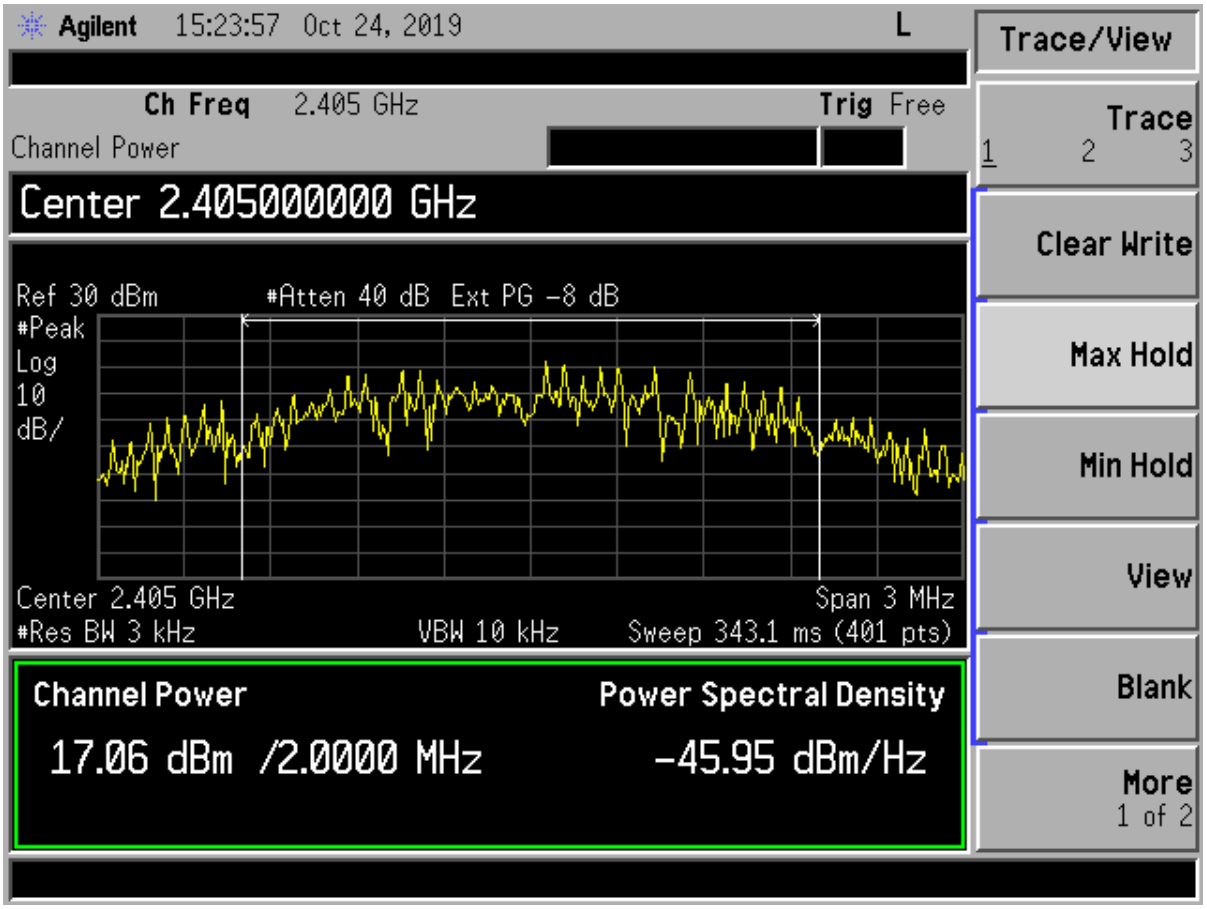


Figure 22. Peak Power Spectral Density, Low Channel

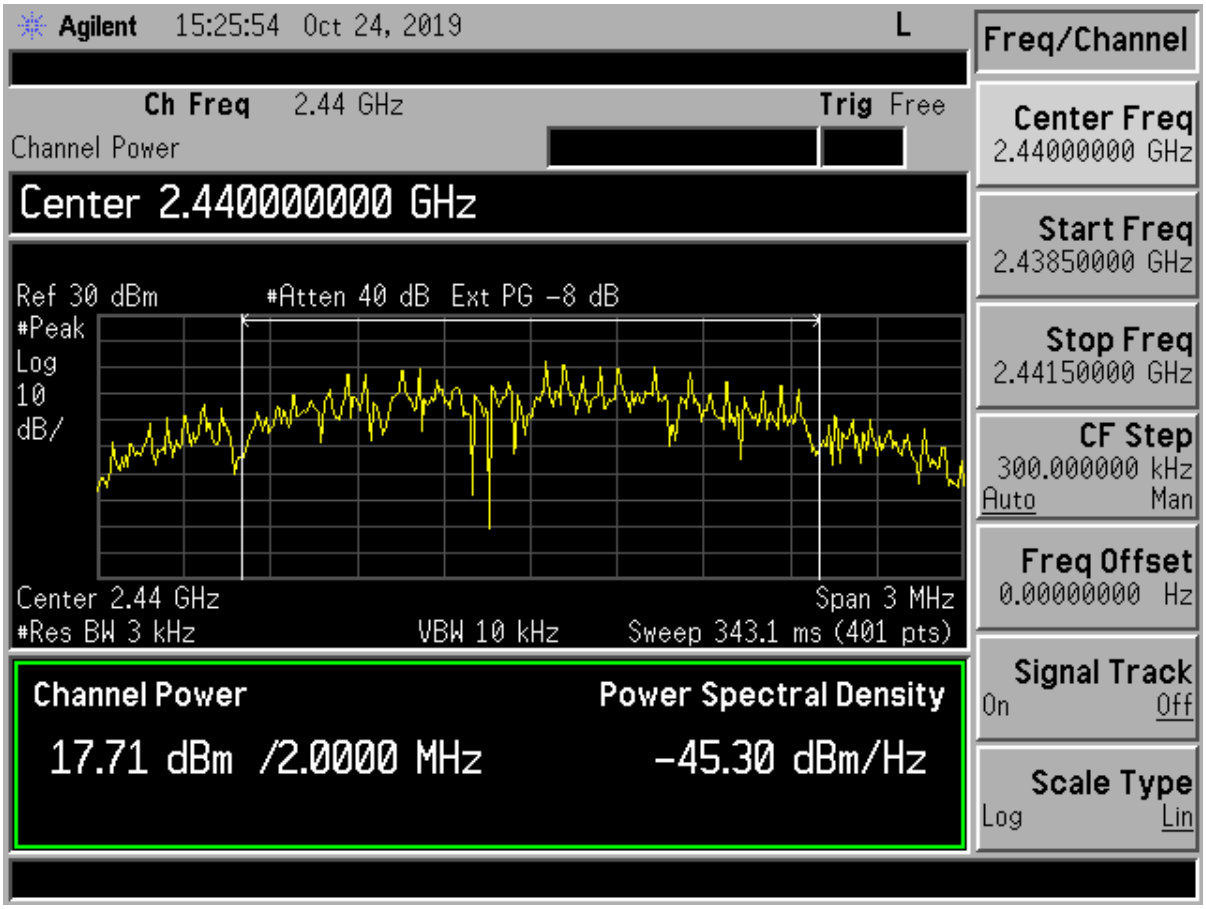


Figure 23. Peak Power Spectral Density, Mid Channel

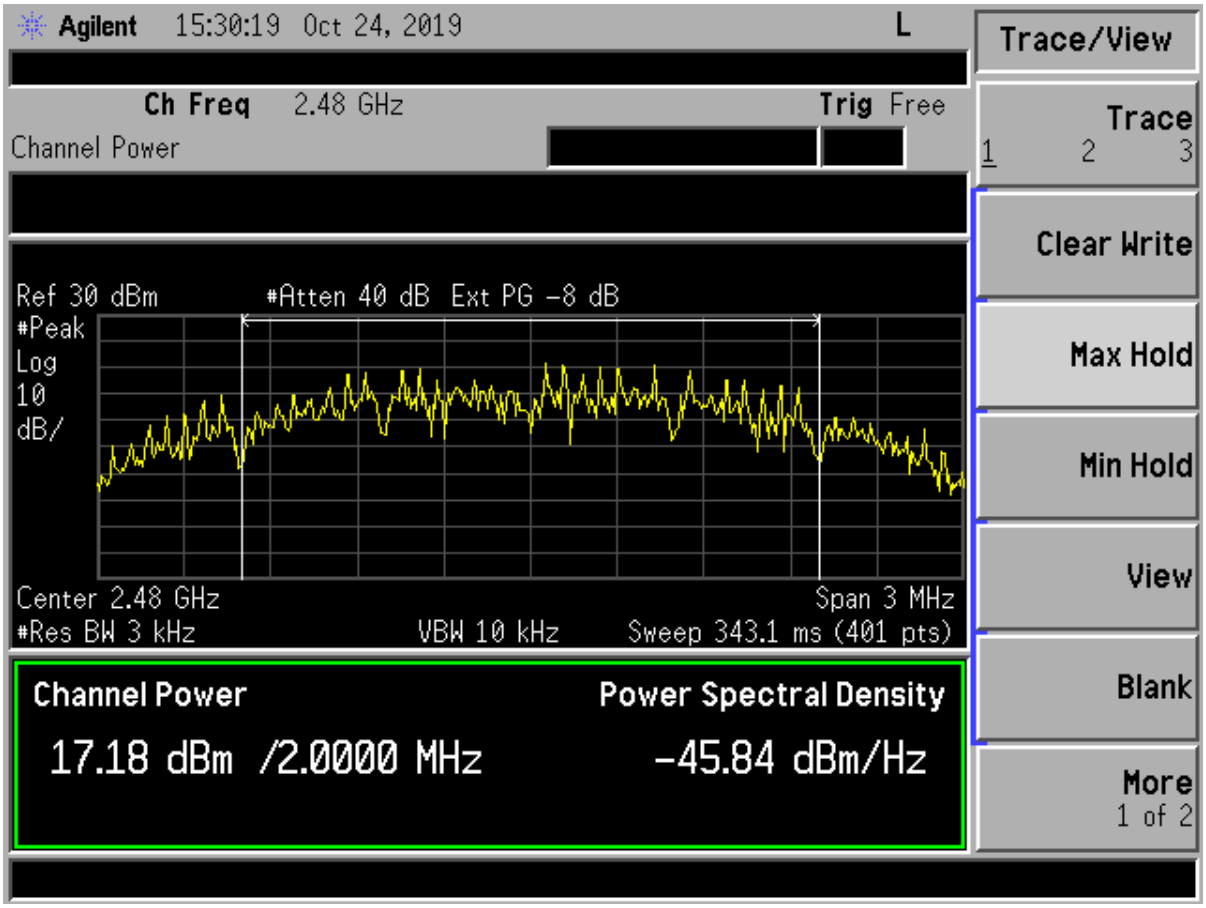


Figure 24. Peak Peak Power Spectral Density, High Channel

2.15 Intentional Radiator Power Line Conducted Emissions (CFR 15.207)

The power line conducted voltage emission measurements have been carried out in accordance with CFR 15.207, per ANSI C63.10:2013, Clause 6.2, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmission.

The EUT is indirectly connected to the AC mains via approved DC power supply adapters. In this case a DC bench power supply was used to supply the EUT with the needed input voltage. The measurements were made with the DC bench supply in place. The DC bench supply is a linear supply and has no internal filter or circuits that will contribute to the EUT emissions characteristics.

The worst-case results for conducted emissions were determined to be produced when the EUT was operating under continuous transmission. The worst case measurement was 12.2 dB from the applicable limit. All other emissions were at least 15.6 dB from the limit. Those results are given in the table below.

Table 10. Power Line Conducted Emissions

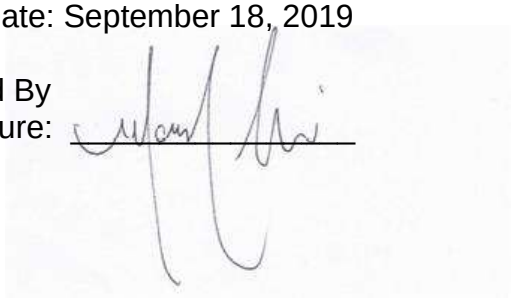
CONDUCTED EMISSIONS 150 kHz to 30 MHz						
Tested By: JF	**Specification Requirement:** FCC Part 15.207		**Project No.:** 19-0287	**Manufacturer:** Okyanus Teknoloji Biligisayar ve Yazilim San.Tic.		
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL (dB)**	**Corrected Results (dBuV)**	**Avg Limits (dBuV)**	**Margin (dB)**	**Detector**
Phase @ 120 Vac/ 60Hz						
0.1838	29.89	0.07	29.96	54.3	24.4	**PK**
0.8017	28.66	0.58	29.24	46.0	16.8	**PK**
1.4930	30.13	0.31	30.44	46.0	15.6	**PK**
5.1750	27.47	0.06	27.53	50.0	22.5	**PK**
12.0833	29.90	0.44	30.34	50.0	19.7	**PK**
24.2000	36.72	1.13	37.85	50.0	12.2	**PK**
Neutral @ 120 Vac/ 60Hz						
0.1533	29.14	0.13	29.27	55.8	26.6	**PK**
0.9033	28.76	0.09	28.85	46.0	17.2	**PK**
1.3267	29.56	0.18	29.74	46.0	16.3	**PK**
6.3667	27.57	0.26	27.83	50.0	22.2	**PK**
12.6167	26.52	0.73	27.25	50.0	22.8	**PK**
24.2000	29.98	1.57	31.55	50.0	18.5	**PK**

(*) Quasi Peak limits were applied.

SAMPLE CALCULATION AT: 0.1838 MHz

Magnitude of Measured Frequency	29.89	dBuV
+LISN+ Cable Loss	0.07	dB
Corrected Result	29.96	dBuV/m

Test Date: September 18, 2019

Tested By
Signature: 

Name: Mark Afroozi

2.16 Intentional Radiator, Radiated Emissions (CFR 15.209)

The test data provided herein is to support the verification requirement for radiated emissions coming from the EUT in a transmitting state per 15.109 and 15.209 and were investigated from 9kHz or the lowest operating clock frequency to 12 GHz and tested as detailed in ANSI C63.10:2013, Clause 6.4-6.6. Data is presented in the tables below.

Radiated emissions within the band of 9 kHz to 30 MHz were investigated using a calibrated loop antenna and per the requirements of ANSI C63.10:2013.

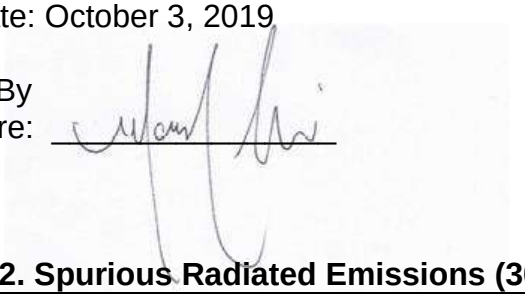
Measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth: 1 MHz RBW and 3 MHz VBW. The test data were maximized for magnitude by rotating the turntable 360 degrees clockwise and counterclockwise and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure.

The worst case configuration was determined to be the EUT set along its X plane. The test data is presented following.

Table 11. Spurious Radiated Emissions (9 kHz – 30 MHz)

Test By: MA	Test: FCC Part 15.209			Client: Okyanus Teknoloji Biligisayar ve Yazilim San.Tic.			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP/AVG**
No emissions were detected.							

Test Date: October 3, 2019

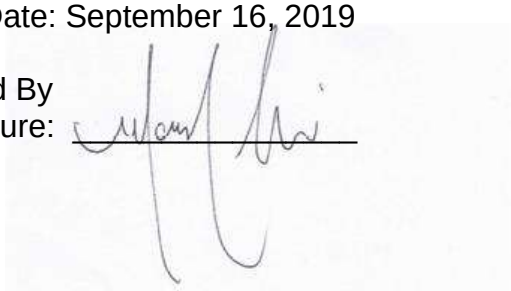
Tested By
Signature: 

Name: Mark Afroozi

Table 12. Spurious Radiated Emissions (30 MHz – 1000 MHz)

Test By: MA	Test: FCC Part 15.109				Client: Okyanus Teknoloji Biligisayar ve Yazilim San.Tic.		
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP/AVG**
No emissions were detected.							

Test Date: September 16, 2019

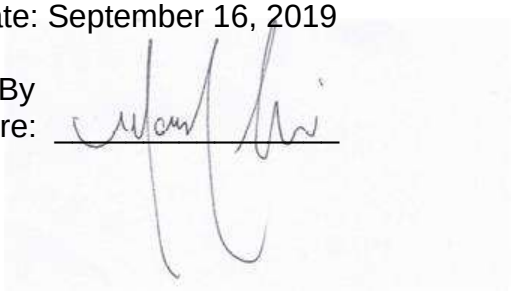
Tested By
Signature: 

Name: Mark Afroozi

Table 13. Spurious Radiated Emissions (1 GHz – 25 GHz)

Test By: MA	Test: FCC Part 15.109				Client: Okyanus Teknoloji Biligisayar ve Yazilim San.Tic.		
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP/AVG**
All emissions other than fundamental and harmonics were more than 20 dB below the applicable limit. Emissions data for fundamental and harmonics are found in Table 6 of this report.							

Test Date: September 16, 2019

Tested By
Signature: 

Name: Mark Afroozi

2.17 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2:2011. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.17.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.78 dB.

2.17.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.1 dB.

3 Conclusions

The EUT is deemed to have met the requirements of the standards cited within the test report when tested as detailed in the present test report.